Experiencing the Future Mundane

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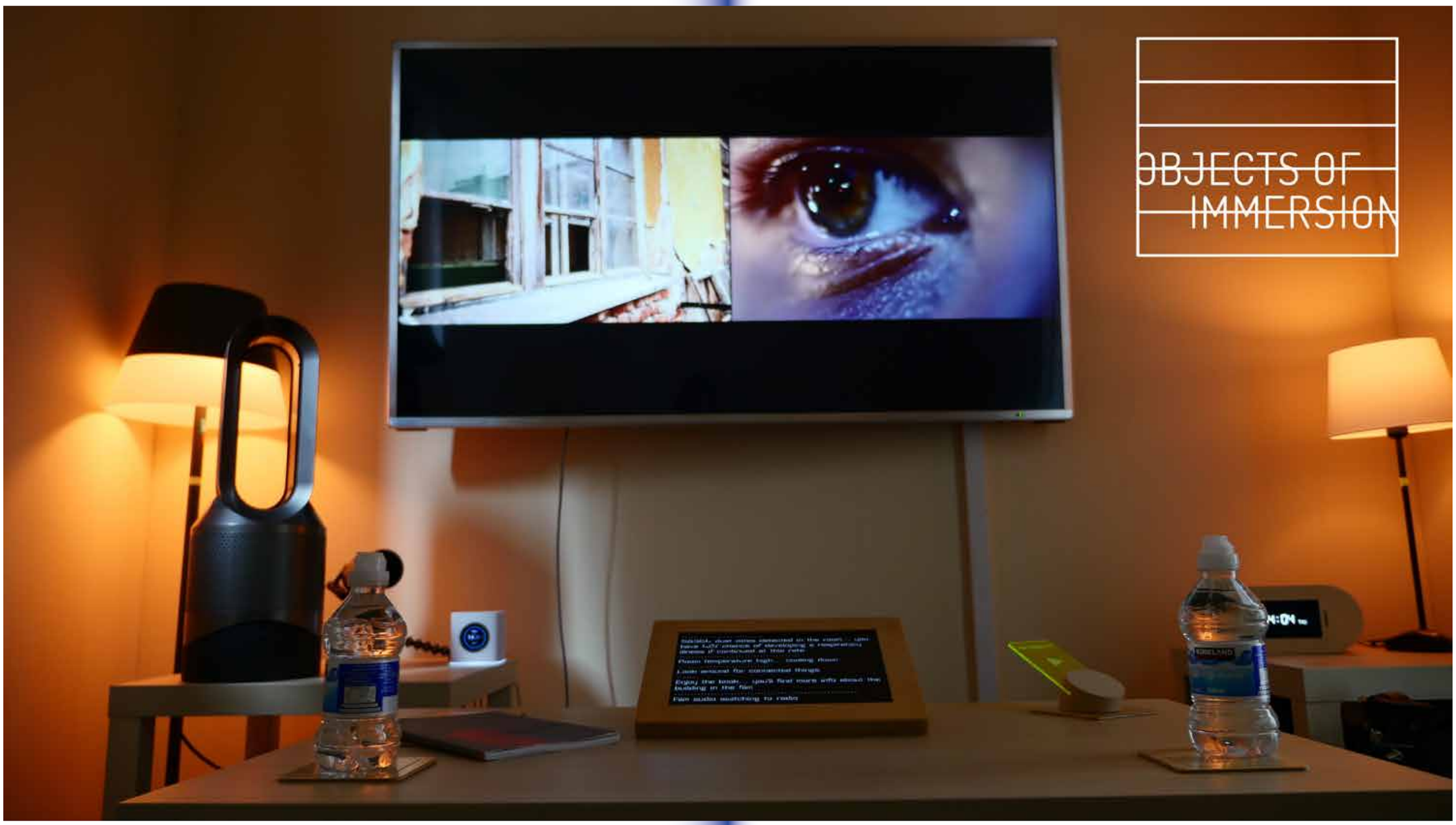
Abstract: Through the design, development and implementation of the Living Room of the Future (LRoTF), we build upon existing work to progress two strands of research. The first explores how media broadcasters may utilize Object-Based Media (OBM) to provide more immersive experiences. Created in conjunction with the BBC R&D the LRofTF utilises OBM to dynamically customise television content according to audiences' personal, contextual and derived data. OBM works by breaking media into smaller parts or 'objects', describing how they relate to each other semantically, and then reassembling them into personalized programmes. In addition to this media-delivery aspect, the LRoTF explores data protection issues that arise from OBM's use of data by integrating with the privacy-enhancing Databox system. The second research focus develops understandings of Design Fiction. While the 'World Building' approach to Design Fiction describes strategies that place emerging technologies in potential futures, this work expands the scope of these prototypes to create a world within which audiences co-produce a 'lived' experience of the future as an 'Experiential Design Fiction'. By combining the audience's context with the fiction's diegesis this research demonstrates a method for extrapolating today's emerging technologies to create an immersive experience of a possible mundane reality of tomorrow.

Keywords: Design Fiction; Immersion; Perceptive Media; Internet of Things; Privacy; Experiential Futures.

Method& Critique



Coulton, Lindley, Gradinar, Colley, Sailaja, Crabtree, Forrester, Kerlin | Living Room of the Future (Image credit Vicky Barlow BBC R&D)

Introduction

The LRoTF utilises OBM to explore BBC R&D's vision of delivering broadcast media that is personalised, adaptable, dynamic, and responsive in order to create new forms of immersive experiences (www.bbc.co.uk/rd/about/vision). To achieve this aim, we build upon existing theory and prior practical work which, in contrast to commonplace approaches that conflate immersion with increased fidelity, propose subtle and nuanced ways to immerse audiences. The resultant prototype is a life-size living room which includes a range of Internet of Things (IoT) devices that enhance the range of contextual data that OBM can use as well as providing physical actuation elements to the immersive media experience. Integration with Databox (www.databoxproject.uk) provides a unique lens on the data aspects of the project, focusing on potential futures where privacy-enhancing technologies and personal data support and enhance our media consumption. Through our reflexive account of creating the LRoTF we explore how the process of World Building for Experiential Design Fictions differs to traditional approaches and ask what are the conceptual differences, and what are the impacts of creative and analytical processes? The paper consists of the following sections. In the context section we explore relevant constructs and prior work in more detail. Then we provide an account of the design, construction, and public exhibition of LRoTF. We conclude the paper with a discussion of how the theories discussed, process of designing, constructing, and observing LRoTF in situ, produce research insights relating to media authoring, data protection, and Design Fiction approaches.

Context

Lenses on Immersion.

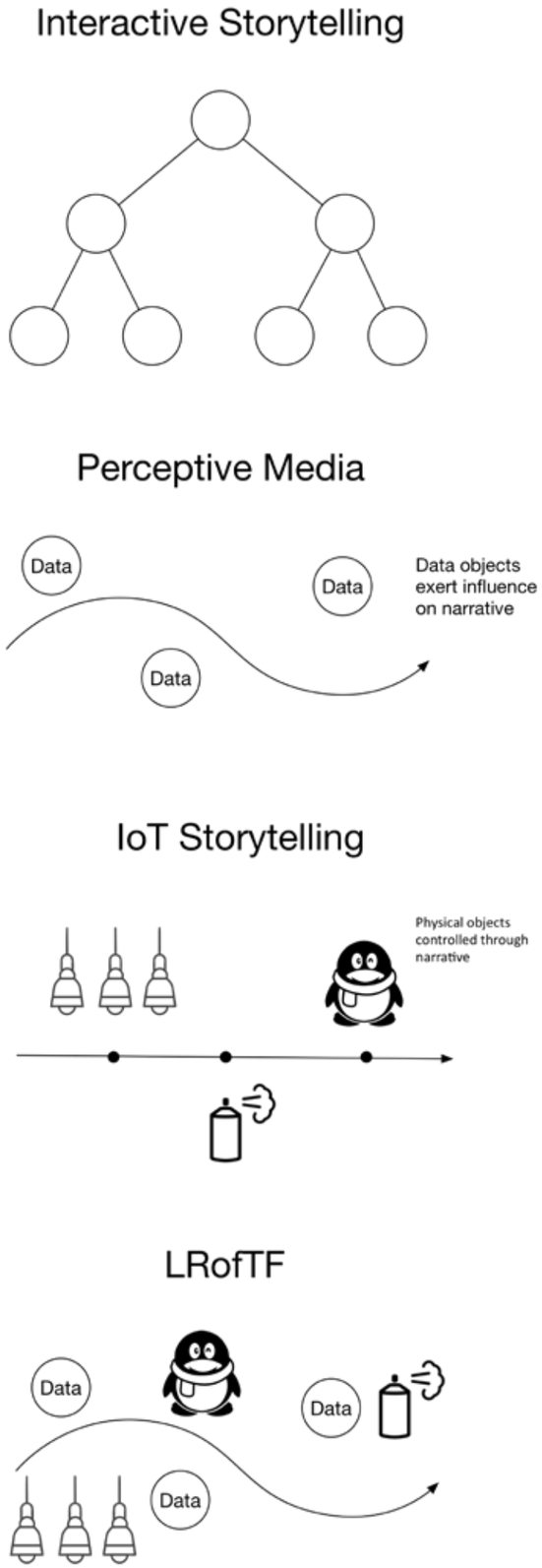
In relation to broadcast media there are many ways to articulate and contextualise what we might mean by immersion, but what unifies the approaches we are interested in is a focus on subtle and ambient immersion. This is in contrast to the frequently held belief that increased sensory fidelity will lead to increased immersion. Marshall McLuhan's distinction between 'hot' and 'cold' media provides a useful lens on this: 'hot' media are those that totally dominate a single sense, and in doing so inhibit one's ability to interpret or participate in the media. Conversely, 'cold' media expands across multiple senses in a non-dominant way, and thus provides a larger interpretive space for the audience to explore. Although technology-facilitated media revolutions outdated some of McLuhan's original examples, the premise still holds, "The hot form excludes, and the cool one includes" (McLuhan, 1964).

Approaches to immersion that utilise Virtual Reality (VR), ultra-high definition, 3D, and High Dynamic Range (HDR) imagery, serve to dominate the audience's sensory experience. Such approaches to immersion can be described as 'liminal', in that their aim is to move the audience between states, transporting them from the real world and into the virtual world that is on the screen or in the VR headset (Coulton, 2017). These liminal media experiences are, in McLuhan's terms, 'hot' and have a tendency to induce a cognitive dissonance in the audience due to the extreme differences between the real and virtual states. Oftentimes the liminality ultimately works against immersion, this is demonstrated most clearly in VR systems whereby visual perception of the displayed world is not matched across the other senses and as a result nausea is a frequent outcome (Regan, 1995).

Contrasting video games with traditional broadcast media provides another insightful lens on immersion. Among the huge spectrum of video games some, for example Grand Theft Auto, exhibit attributes of hot media while others, for example Minecraft, are more low fidelity, but both are frequently described as highly immersive. They achieve this in ways that broadcast media usually cannot. For example, games usually require interaction with the audience in order to progress the content. Moreover, because each play session is entirely unique games are fully personalised experiences. Traditionally, the personalisation that broadcasters offer manifests as content-suggestion systems. In contrast, and aspiring to BBC R&D's vision for the future, LRoTF aimed to explore content-centric personalisation. Focusing on approaches that minimise the liminality of high-fidelity media that draw upon the ultimate particularity of video gaming, LRoTF aspired to create a 'cool' but personalisable immersive media experience.

Related Work.

LRoTF draws upon prior research into Perceptive Media, IoT Storytelling, and Interactive Storytelling. Interactive Storytelling involves audiences making choices to navigate a pre-defined narrative as per the recent Black Mirror film, Bandersnatch. Perceptive Media, in contrast, utilises contextual information relevant to audiences and data gathered using a range of sensors to subtly alter the media without depending on direct action. Although



the overall story arc remains the same for each viewing, ambient aspects of the narrative to tweak the way media is presented in order to create a more engaging, context-specific experience for the audience (Gradinar et. al, 2015). Similarly, IoT Storytelling builds upon a fixed story arc, but augments how it is delivered by synchronising on-screen events with IoT devices that act physically within the viewer's own context (Coulton, 2017). Both Perceptive Media and IoT Storytelling are reminiscent of non-technical approaches to immersion. For example, a storyteller may adapt aspects of the story's interior world to the particularities of the location and the group of listeners (as in Perceptive Media), or may increase audience immersion by referring to local landmarks or the current weather conditions (per IoT storytelling). These ways of altering how the story is delivered, either by reacting to the audience's context or by altering the physical environment, we describe as 'diegetic influencers'.

By breaking down a film, television or radio programme semantically into objects, and defining how those objects relate to each other so they can be dynamically recombined, OBM is a tool to help deliver immersive experiences, such as those enabled by Perceptive Media. OBM considers all different parts of the media as objects; for example, video sequences, sound effects, music tracks, sign-language overlays and subtitles. By encoding the semantic relationships between these objects OBM can reconfigure and customise content depending on the audience and context. Examples

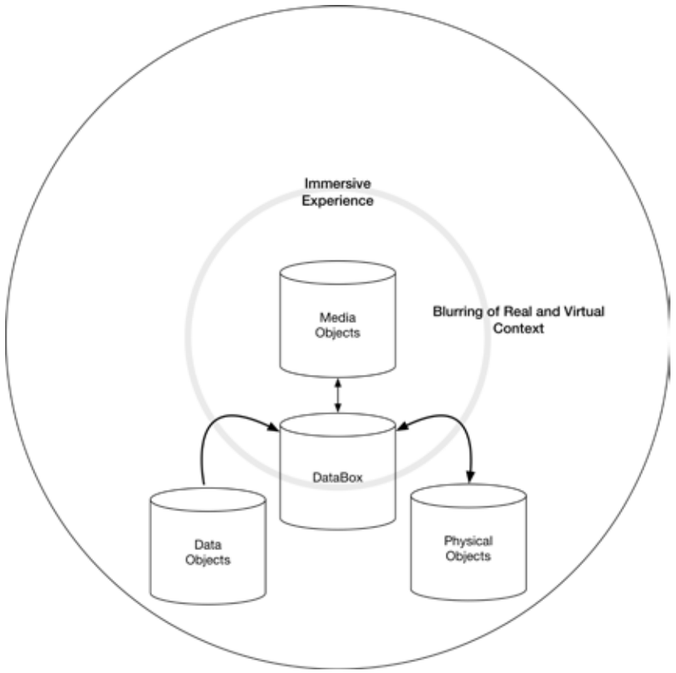
Figure 1. (Top) Interactive Storytelling; (Middle) Perceptive Media; (Bottom) IoT Storytelling.

of how OBM can be used include abridged catch-up versions of soap-operas allowing viewers to catch up on several missed shows in a short amount of time without losing any of the salient events; dynamic sound mixing to make content more accessible to those who are hard of hearing; content automatically targeted to viewers based on preference (e.g. for fans of a sports team, or a specific band).

The aforementioned approaches to immersion utilise data about the audience context and objects within that context and have demonstrated how those techniques can be employed. However, they did not address any implications for privacy or data protection. Noting this omission, LRoTF addresses this by utilising the Databox project's unique ecology for exploiting personal data in privacy-preserving ways (Colley and Crabtree, 2018). Databox enables a media provider to utilise algorithms on data about an individual's viewing habits, as well as other individuals in the room, and offers up bespoke content of mutual interest without disclosing personal data to the provider. Instead of distributing personal data to remote cloud servers for processing, processing takes place on-the-box (edge computing), which means no personal data need leave the home or be accessed by anyone else (Figure 2).

Constructing an RtD Strategy

The LRoTF was realised by focusing the aforementioned immersion lenses onto the approaches described in the related work. The prototype was built utilising OBM, a variety of IoT devices, and Databox. In the following we describe how we extend the functionality of OBM such that it delivers attributes of both Perceptive Media and IoT Storytelling. Central to this aim is a conceptual shift away from the jarringly-transient liminal experiences of immersion enabled by hot media like VR. Instead, LRoTF aimed to deliver a 'liminoid' experience (Coulton, 2017), these are media that rather than facilitating transfer between entirely separate real and virtual contexts, aim to unite both contexts together, to be experienced at once (Figure 2). The aspiration is that liminoid experience can,



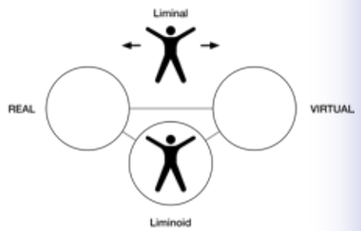


Figure 3. (Top) Liminal - on the threshold or moving between states and Liminoid - occupying an intermediate position between states, (Bottom) LRoTF immersive experience.

Figure 2. Living Room of the Future System Diagram.

through this contextual unification, provide media experiences that are immersive but significantly cooler than approaches such as VR, are more inclusive, and are truly personalised. By creating this hybrid experience that dynamically adapts fictional components of the media depending on context, the emotionally engaging and intuitive type of immersion we aspired to create may be enabled.

Orson Welles' famous retelling of War of the Worlds on radio in 1938 is an example of how such emotional engagement can deliver immersive experience. The broadcast allegedly produced a panic amongst the show's listeners who believed the account of an alien invasion of planet Earth, to be real. Whilst the scale of the panic is much disputed, it is clear it did have a palpable effect on the audience (Campbell, 2010), thus highlighting that by making content contextually relevant to an audience, the media can produce levels of emotional engagement and immersion so compelling that, in some cases, it can even override logical reasoning. The speculative design strategy that we utilised for this project, Design Fiction, leverages prototypes that can exhibit a similarly immersive quality.

"While Marshall McLuhan famously said the medium is the message, we would argue that by transcending the designer's intentions and becoming entangled with the audience's assumptions and inclinations, in design fiction the format is the message. This is perhaps best described in metaphor by appropriating the duck test, 'if it walks like a duck, quacks like a duck, then it probably is a duck'." (Coulton, Lindley and Akmal, 2016)

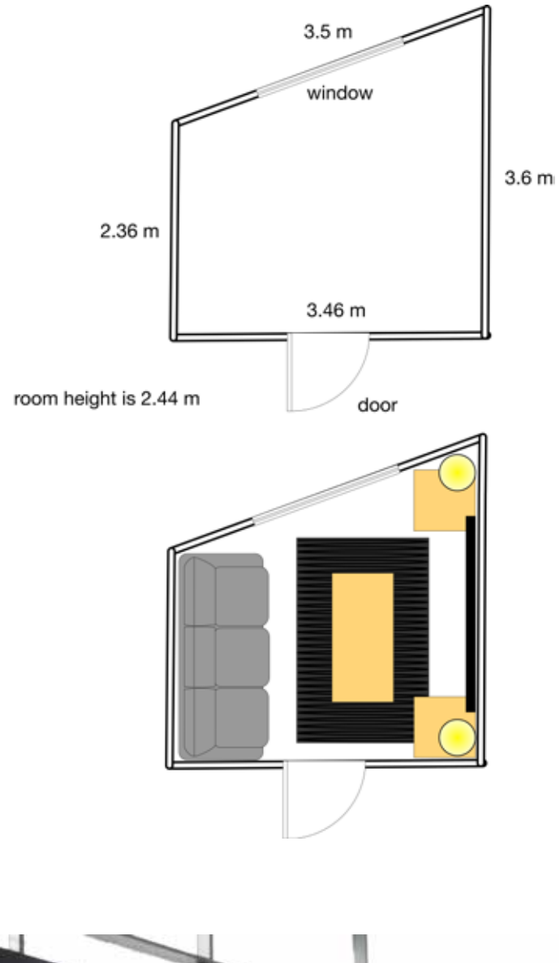
By leveraging media, formats, and contexts that are effortlessly familiar to the audience (i.e. things that walk and quack like the proverbial duck), Design Fiction practitioners immerse their audience in the artificial reality that the fiction aims to create. By immersing their audience in this way, Design Fictions that achieve this effect could, in McLuhanian terms, be described as 'cool' media. For some time, Design Fiction has been described as pre-paradigmatic, meaning that there are numerous incongruent perspectives on both what it is and what it is for. Upon this pre-paradigmatic tundra, Design Fiction as World Building (Coulton et al, 2017) is a relatively well defined approach, and in this research we align with its considerations. Transcending the limitations that are inherited by associating Design Fiction with notions of story and narrative, 'World Building' aims to create plausible depictions of the near future within which today's emerging technologies may be prototyped as if they are domesticated technologies situated in everyday life/culture (Lindley, Coulton, Sturdee, 2017).

Traditional approaches to World Building achieve this by creating artefacts which, together, give rise to future 'worlds', the 'world' prototypes the 'things' that are situated and domesticated within them, and those 'things' repay the favour and prototype the future 'world'. This reciprocal prototyping loop enables researchers to ask, and answer, questions like "what might it be like to live surrounded by IoT 'things' integrated in your living room, kitchen or bathroom?", and by striving to represent technologies as if they are domesticated and mundane, Design Fiction explores proximate futures in a uniquely subtle and situated way. This distinctive property of Design Fiction reiterates the approach's potential to produce the kind of liminoid experience that LRoTF aspired to create.

The approach we adopted, which is described in the subsequent section, draws together the related work and theories described thus far as part of an Experiential Design Fiction. In order to achieve this, we combined and extended the foundations provided by Perceptive Media and IoT Storytelling, in order to explore broadcast media that is liminoid-and-cool, and hence to experiment with more inclusive immersion. We did this using IoT devices, OBM and through integration with Databox in a way that is sensitive and responsive to privacy concerns relating to personal data. (Colley and Crabtree, 2018)

Designing the Living Room of the Future Experience

Until recently living rooms were the sole media-consumption hub of most homes, but today, with the ubiquity of screens and mobile devices the reality is that media are consumed wherever the audience requires. However, for this project we constructed the prototype around a living room as it is still a common spatial configuration within homes, and most importantly, is universally understood by the general audience providing a familiar foundation for our immersive liminoid experience. From the outset of the project the intention was to install LRoTF at the Foundation for Art and Technology (FACT) gallery in Liverpool (UK) as part of a public exhibition. Hence, the dimensions of the living room we were creating were fixed by the available space in the gallery (Figure 4). Within the available exhibition space the internal furnishings (a sofa, TV, coffee table, side tables, and lamps) were selected and installed to create a familiar living room ambience. In the following we describe how the connected IoT devices in the living room, media displayed on the screen,

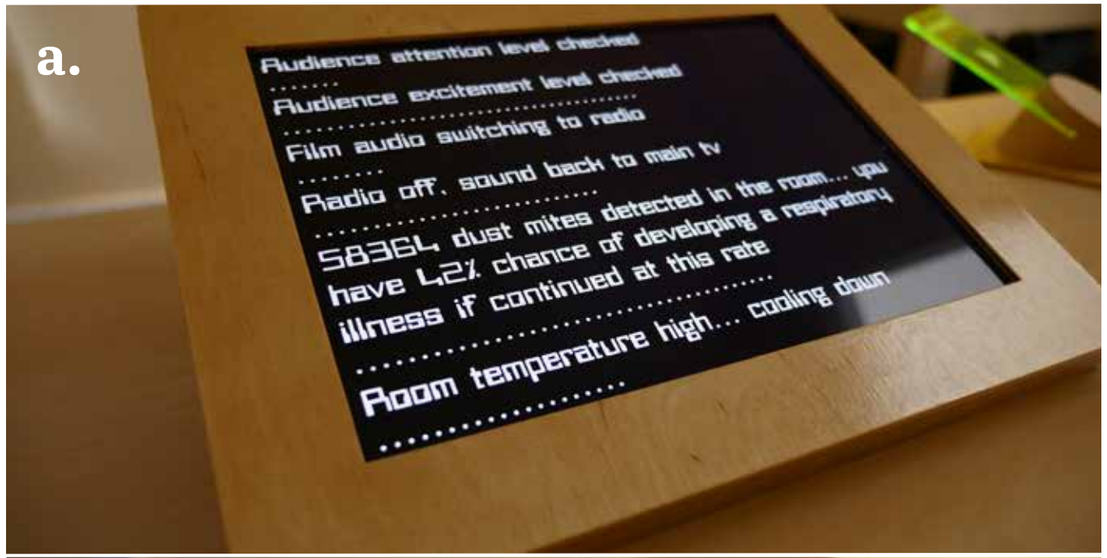


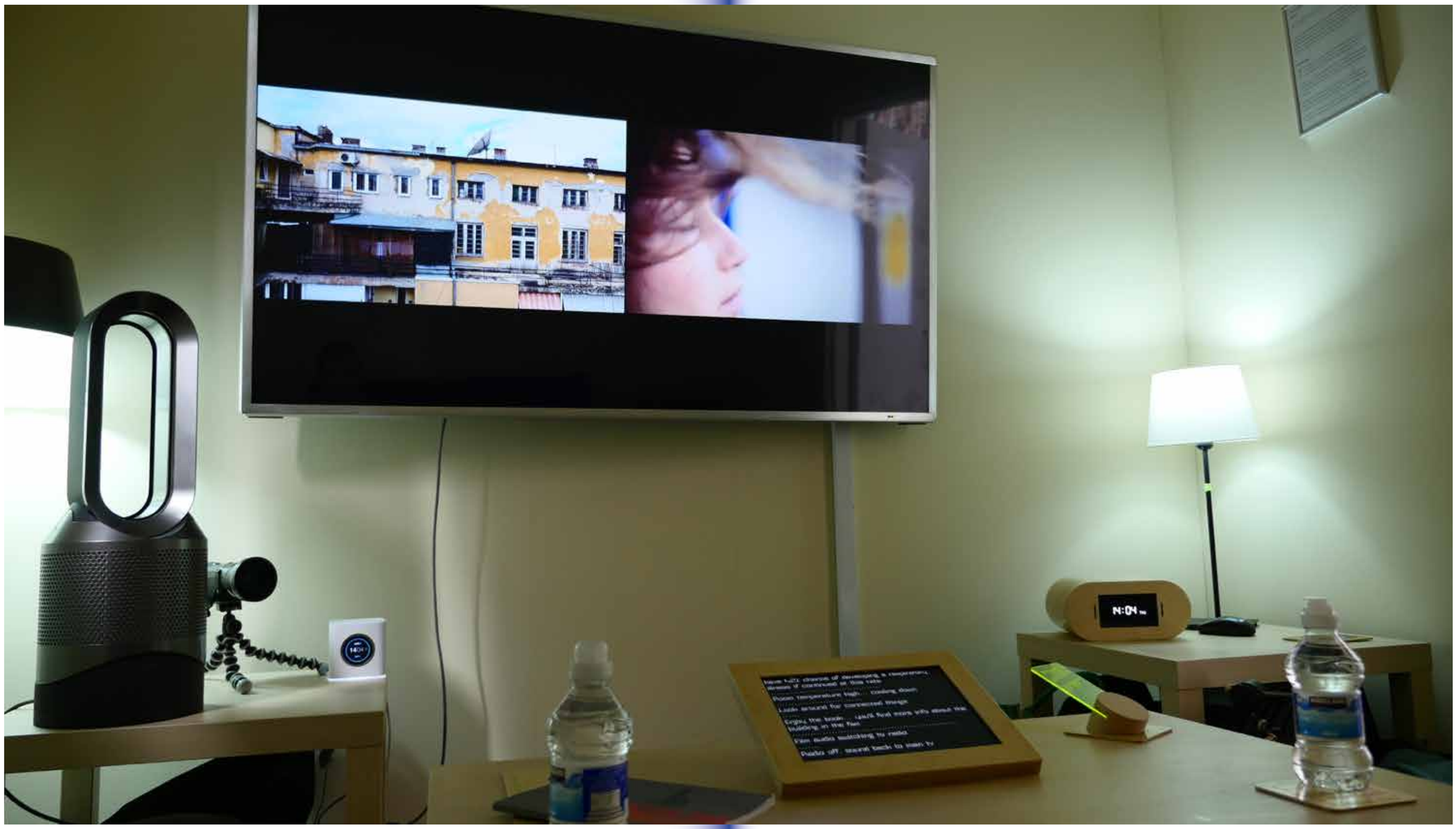
and the technical aspects such as OBM and Databox were brought together to create the full prototype experience.

Objects.
We identified a selection of off-the-shelf IoT products including programmable lights, a fan, window blinds, and smart plugs, to incorporate into the LRoTF. In addition to these commercially-available products, we built some IoT devices from scratch. These included a clock-radio, whose speaker became the voice of the room; a series of sensors to detect audience interactions with objects in the room (including a book, a bottle of water, and a remote-control device, and the sofa); a printer integrated into the coffee table. The commercial products and the printer may be seen as 'outputs' of the LRoTF, whilst the sensors are 'inputs'.

Figure 4. (Top) Room dimensions and layout, (Bottom) Room in situ.

Figure 5. Facing Page. (a) Console revealing data flows, (b) Clock radio - voice of the living room, (c) data receipts from living room experience (Image credit Vicky Barlow, BBC R&D)





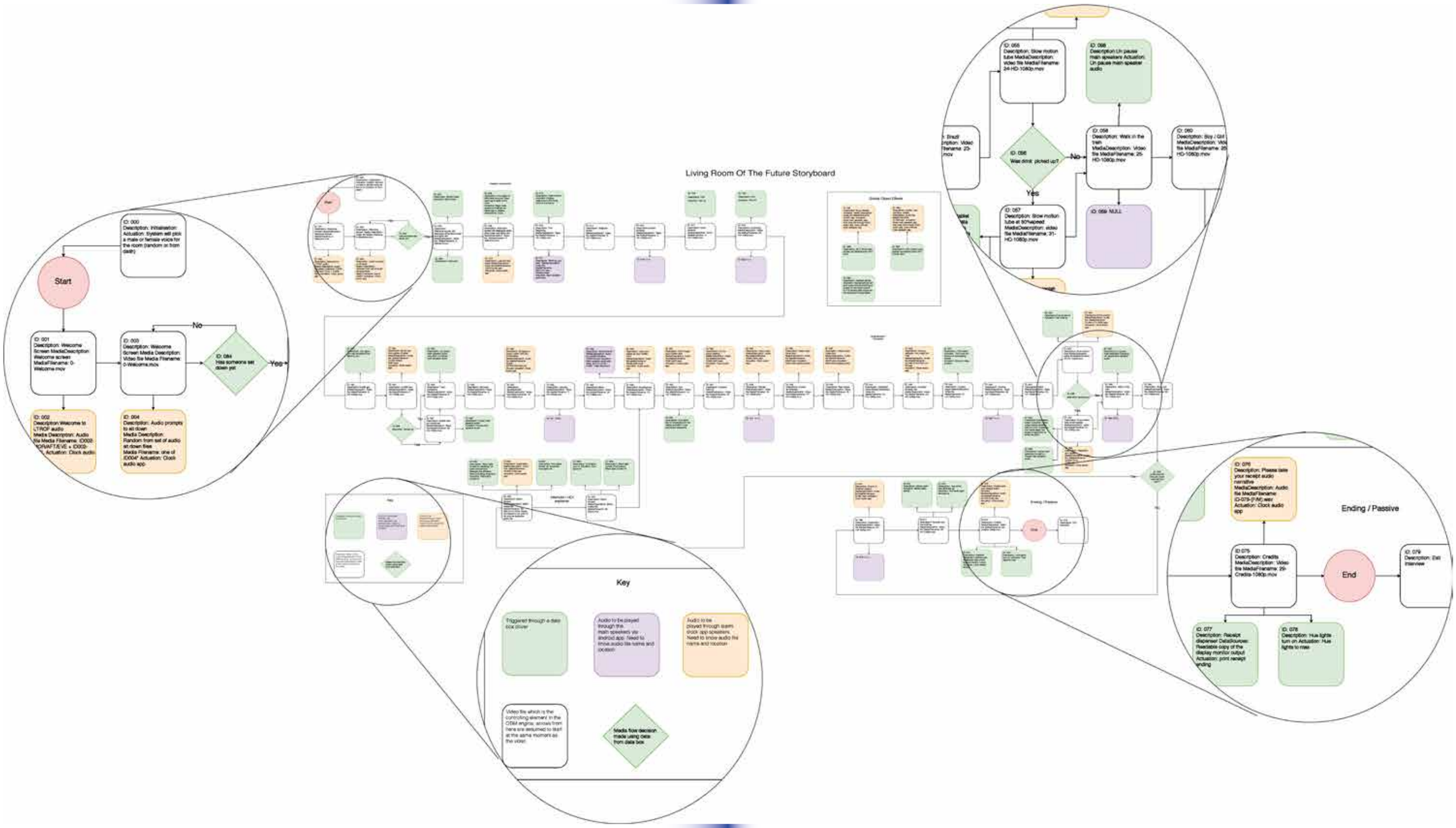
Media.

In this initial version of the LRoTF a film was used as the foundation for the immersive media experience. The film developed during a 3-weeks residency sponsored by the British Council for two film makers who had been selected from a previously held workshop on the future of storytelling. This ambient art film has no specific linear narrative and includes drone footage shot around derelict buildings in Sarajevo juxtaposed against shots of rail journeys in London (Figure 6).

Technical.

Designing and building the LRoTF was a significant technical challenge and required a 'stack' of bespoke technical layers to function properly. In order to take advantage of the privacy-enhancing features in the LRoTF all data moving through the system was managed by the Databox architecture. This is a unique feature of LRoTF not present in similar prototypes, and required that various bespoke software drivers for Databox be created. The Databox drivers are the interface between LRoTF and the IoT devices around the room. The OBM tool is a pivotal part of the LRoTF's stack, and, is a standalone and pre-existing tool that was adapted for this project.

Figure 6. The image on the left of the screen in the image is of Sarajevo whilst the image on the right shows the London underground.(Image credit Vicky Barlow BBC R&D)



The ‘objects’ that the OBM tool usually works with are the given media’s constituent parts (e.g. sound, film clip, subtitle). Whilst these objects still exist within the LRoTF, we extend the system such that the IoT devices around the room are objects too. These serve two purposes: first, they capture and generate data providing contextual data about the audience and the physical world to the OBM system (as in Perceptive Media); second, they provide a means for the OBM system to act in the world, extending the scope of the media beyond the screen (as in IoT Storytelling). OBM encodes and manages how all of the objects relate to each other semantically, and in conjunction with the media objects, the sensing/actuaing IoT devices, and Databox, OBM choreographs the whole experience (Figure 7).

Figure 7. The storyboard is used as reference for OBM tool to integrate the media, data, and physical objects to produce the overall experience.

Experience.

In order to sit comfortably within the wider exhibition at FACT we tailored the whole duration of the experience to last between 8 and 10 minutes. During this time the film’s narrative arc would complete and OBM would exhibit a range of physical actuation through the IoT devices in the room, and demonstrate responsiveness via utilisation of the sensors. Some interactions in the room were constant: for example, the clock radio always welcomes audiences when they sit down, at the start of the film the blinds come down and the lights dim,

when the wind blows in a girl's hair the fan starts up, and the room's lighting adapts in colour and brightness to match each scene. By gathering sensor data from around the room (mediated by Databox), OBM also facilitated more dynamic interactions. For example, if a smartcard used for travel around London (Oyster card) was picked up then the footage of the tube journey was amended, if the water bottle was moved from the coffee table more footage of rain was shown, and if users removed a book from the table after the main film completed a supplementary film relating to the content of the book was shown. As with Perceptive Media the impact of particular interactions are not shown immediately but are delivered asynchronously and subtly. This means that while each experience was uniquely tailored to the audience, they would not necessarily be able to see why or how. While this structure, without obvious evidence of interaction supports the delivery of a liminoid-cool immersion, concerned that it could also leave audiences confused as to the intricacies of what is happening behind the scenes, we added a monitor to the surface of the coffee table that shows when the items were picked up which highlights how the path through the film is being personalised.

Once the narrative arc has completed the IoT smart plug was triggered by OBM to turn on a Ultra Violet (UV) light unit concealed in the ceiling. The relevant devices had been constructed using materials that fluoresce under UV light, a property that we utilised to show where the interactive elements in the room were, and the paths that data took between the devices, the media and Databox (Figure 10). At the end of the experience the OBM turns the lights back on, raises the window blind, and the receipt printer housed in the coffee table produces a hardcopy receipt which details what data has been gathered from the audience, and how it has been used to deliver the experience (Figure 5c). The information on the receipt makes it clear how and why data is transmitted via Databox to third parties, as well as around the room.

Audience Reaction.

In a forthcoming article, an analysis of user experiences of 59 people who agreed to be interviewed in 30 groups of up to 3, utilising an ethnomethodological approach, reveals an immersive, but not unproblematic experience. Feedback suggests the cool media experience we aspired to was delivered, with one participant describing it as *"Magical"*. Another said *"It was very immersive"*, while their partner added *"It's not just looking at a 2D screen in front of you. It's creating the whole mood and everything."* The tablet display on the coffee table was a key feedback mechanism, *"I interacted with the room and the room reacted back to me"* as well as being transparent about how the room utilised data *"If the screen wasn't there then I would have no idea that that sort of data would be collected"*. Notwithstanding the utility of the tablet, some participants noted that while it showed which data were being collected and when, it did little to explain why those data were being collected and/or utilised. Further and most notably with respect to the acceptability of the system, the cohort of participants demarcated how they encountered LRoTF in the gallery with how they may encounter it in 'real life'. In the gallery the privacy concerns relating to how LRoTF utilises data were novelties but when imagining the same situation at home, participants found the way sensors in the room made the system work to be distasteful. Users also noted how LRoTF could shift agency away from users and into the technicality of the room itself, identifying the potential for such a system to create and reinforce filter bubbles.

Figure 8. Interactive smartcard (Image credit Vicky Barlow BBC R&D)

Figure 9. Interactive book (Image credit Vicky Barlow BBC R&D)

Figure 10. UV reveal testing (Image credit Vicky Barlow BBC R&D)

Discussion and Conclusions

This research addresses two distinct topics—using OBM to explore immersive broadcast media and Experiential Design Fiction—and whilst we will present specific insights relating to each thread, as is often true with RtD processes, the two are intertwined. The practicalities of delivering cool and liminoid immersive experiences are cast in a new light that, although built from the theoretical position discussed, put the everyday considerations of a media producer at the centre of the exploration. Whilst these are most saliently communicated by considering the design and implementation of the LRoTF itself some indicative examples include: adapting a film to work with OBM (as opposed to creating one for OBM) complicates the production process, as the more personalisation to be incorporated the greater the number of media objects that need to be produced/encoded within OBM; while placing Databox at the core of the system adds a unique and powerful privacy-enhancement this is traded off against ease of integration with other devices; when a cool/liminoid immersive media experience is working 'well', it should blend into the background, and the audience are usually not aware of it. This final point presents a challenge to researchers attempting to evaluate such an experience (incidentally a challenge that RtD approaches are apt to address), it is also indicative of how personalised media may alter audiences' expectations of broadcast media. Films, television programs, and radio shows are often the subject of conversation as a shared experience during and after broadcast but if the media is experienced differently for individual audience members what is the effect on sharing, does the personalisation add or detract, how might we determine an optimal level to balance shared experience with personalisation? Our participants were clearly concerned about the potential for experiences to homogenise content based on profiling, *"it tailors what you see [...] I think that's horrible"* and although the research presented did not address this directly, the LRofTF provides a platform on which the spectra of possibilities may be evaluated in future work.

The Design Fiction world which LRoTF is situated in intentionally blurs the boundary between the audience's context (i.e. 'reality') and diegetic context (i.e. the mundane future depicted). While World Building approaches to Design Fiction have used multiple artefacts as entry points to create a cohesive-and-artificial world, they have tended to put the onus to 'penetrate' the surface of that world on to an audience or viewer. LRoTF differs beacuse it places the audience directly within the diegesis, achieving an embodied rather than cognitive suspension of disbelief. LRoTF has some resonance with Speculative Enactments' direct involvement of people in the speculation (Elsden et al., 2017), however the fully situated performativity required by the LRoTF's fullsize functional prototype is indicative of contrast too. Throughout the LRoTF project it has been clear that there is a symbiotic relationship between the immersive media that this research addresses and the Experiential Design Fictional strategy employed to explore those media. Put differently the ends of this research (new insights relevant to both topics) and it's means (building the LRoTF) are commensurate with one another. It is evident from the LRofTF that how experiences of the future are performed or embodied, and the extent to which participants are situated within the experience, is an important consideration within the design process of any Design Fiction.

Based on this research we suggest that framing Experiential Design Fictions as cool and liminoid provides the foundation to pose *What If?* questions in such a way that they can be tactfully explored through embodied suspensions of disbelief. This seems particularly pertinent when Design Fiction is utilised as part of a Human-Centred or Participatory Design process as it provides a simple and powerful means to include stakeholder groups directly with a proximate future and that future's potential implications. In this way, such Experiential Design Fictions provide a means to explore the mundanity of living in speculative futures that are based upon, but not limited to, the world as it is imagined by the designer.

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References

Campbell, W.J., 2010. Getting it wrong: ten of the greatest misreported stories in American journalism. Univ of California Press.

Colley, J.A, &. Crabtree, A. 2018. Object based media, the IoT and Databox, in Proceedings of Living in the Internet of Things: Cybersecurity of the IoT - 2018, London, 2018, pp. 1-6. doi: 10.1049/cp.2018.0034

Coulton, P, Lindley, J & Akmal, HA 2016, Design fiction: does the search for plausibility lead to deception? in Proceedings of DRS 2016, vol. 1, Design Research Society, pp. 369-384, DRS 2016 : Future Focused Thinking, Brighton, United Kingdom, 27-30 June.

Coulton, P 2017, Sensing atoms and bits. in I Heywood (ed.), Sensory arts and design. Bloomsbury, London.

Coulton, P. et al. (2017) 'Design Fiction as World Building', in Proceedings of the 3rd Biennial Research Through Design Conference. Edinburgh, UK, pp. 163–179. doi: 10.6084/m9.figshare.4746964.

Elsden, C. et al. (2017) 'Abacus Datagraphy : A Speculative Enactment', Proceedings of the 3nd Biennial Research Through Design Conference. Edinburgh, UK, pp. 148–162. doi: 10.6084/m9.figshare.4746961.Image.

Gradinar, A, Burnett, D, Coulton, P, Forrester, I, Watkins, M, Scutt, T & Murphy, E 2015, Perceptive media: adaptive storytelling for digital broadcast. in Proceedings INTERACT 2015 The 15th IFIP International Conference on Human-Computer Interaction, Bamberg, Germany, 14-18 September.

Lindley, J., Coulton, P. and Sturdee, M. (2017) 'Implications for Adoption', in Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17. New York, New York, USA: ACM Press, pp. 265–277. doi: 10.1145/3025453.3025742.

McLuhan, M., 1964. Understanding media: The extensions of man. McGraw Hill.

Regan, C., 1995. An investigation into nausea and other side-effects of head-coupled immersive virtual reality. Virtual Reality, 1(1), pp.17-31.

Figure 11. Living Room of the Future launch event at FACT Gallery Liverpool (Image credit Vicky Barlow BBC R&D)

Figure 12. Living Room of the Future at Victoria and Albert Museum in London for London Design Festival (Image credit Ian Forrester BBC R&D)

Figure 13. Living Room of the Future at PlayUK event In Skopje Macedonia (Image credit Ian Forrester BBC R&D)